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Hawaii Agricultural Experiment Station,

HONOLULU

J. G. SMITH, SPECIAL AGENT IN CHARGE

PRESS BULLETIN No. 16 *

THE AVOCADO MEALY-BUG

(*Pseudococcus nipae* Mask.)

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The enemy of the Avocado or Alligator pear (*Persea gratissima*), commonly known in and about Honolulu as the "blight of the Alligator pear" or simply as "pear blight," is, properly speaking, not a blight at all but an insect, one of the mealy-bugs, *Pseudococcus nipae* Mask., belonging to the same family, *Coccidae*, as do scale-insects. This family is related to the plant-lice and leaf-hoppers of the order Hemiptera. "Blight" is a term in common use by botanists, or rather plant pathologists, to designate certain fungus diseases of plants, these fungi being low parasitic forms of plant life. Besides the great injury and disfigurement caused by this mealy-bug to the foliage, fruit and leaf buds, and terminal branches of the Avocado, the pest infests the fig, grape, guava and bread-fruit.

The Avocado mealy-bug was described in 1892 by Mr. W. M. Maskell under the name *Dactylopius nipae*. The specimens were received by Maskell from Demerara and were taken from an aquatic palm, *Nipa fruticans*.[1] The insect is recorded for the first time in the United States in the Canadian Entomologist with the following note: "Found for the first time in the

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* Reprint of Press Bulletin No. 8

[1] Trans. and Pro., New Zealand Institute, 1892, Vol. XXV (1893) pp. 232–233.

U. S., in the Harvard botanical greenhouse at Cambridge, Mass. Introduced."[2] Mrs. Fernald in her catalogue of the Coccidae of the world records the species from Demerara, Mexico and Massachusetts.[3]

GENERAL ACCOUNT.

The Avocado mealy-bug and its related forms, including the scale-insects, represent the most injurious family of insects with which the horticulturist in a tropical country has to contend. The short life-cycle and immense increase in succeeding generations render them capable of appearing in enormous numbers on their respective food plants within a very limited space of time and, in many instances, before their presence is detected by the owners of the trees or plants. The ability to recognize these insidious foes before serious injury is accomplished will enable the grower to check the increase before the pests become epidemic.

In general the life-history of the members of the family Coccidae is as follows: The young, with few exceptions, are hatched from minute eggs. It is during the egg state, particularly, that these serious plant pests have been transported long distances, making the distribution of many species almost world-wide. The young possess legs, a distinct head and their mouth-parts are formed for sucking. Soon after hatching, they disperse over the plant to feed. This they do by inserting their beak-like mouth or proboscis into the tissues and sucking from the plant its sap. The result of myriads of individuals engaged in this operation can be imagined to have a very disastrous effect on the health and even the very life of the infested plant. As growth and the consequent development take place, these small insects cast off their skins to provide for the increase in size. During the developmental period the males are not unlike the females in appearance.

When full-grown the females remain stationary or practically so, having undergone an incomplete metamorphosis. All the female Coccidae are either partly or entirely covered by a wax-like, scaly, powdery, or cottony excretion and also in some instances further enveloped in the adult stages by the addition to such excretion of the cast skins of the younger stages. The waxy covering of the female insect affords a place of protection to the eggs and newly hatched young and offers more or less resistance to the action of the various insecticides in use to destroy them. In some instances the covering is scale-like, in others cotton- or meal-like. Thus we have the common names, as for example, scale-insect, mealy-bug and cottony cushion-scale. The conspicuous part of the Avocado mealy-bug is its white meal-like covering. The color of the body is yellow varying to orange. On slight pressure the body of the fully matured female exudes a bright orange fluid. Fully developed females are represented on the under side of a leaf in figure 1.

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[2] King. Can. Ent., Vol. XXXIV, No. 3, 1902, p. 59.

[3] Bul. 88, Mass. (Hatch) Experiment Station, 1903 p. 107.

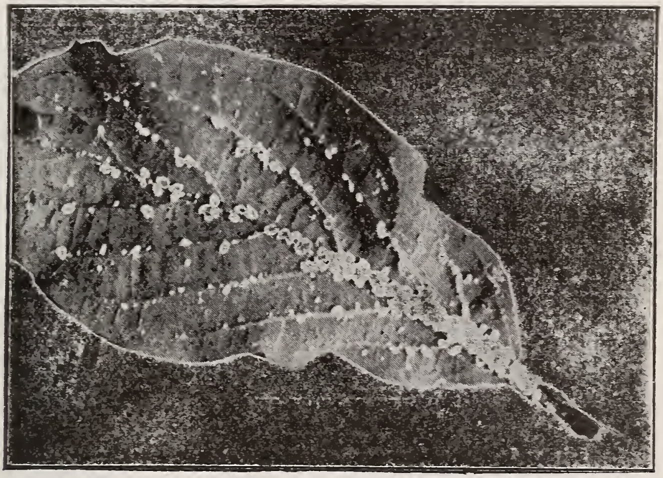

Fig. 1.—The Avocado mealy-bug, *Pseudococcus nipae* Mask., on the underside of a leaf of the Avocado. (original).

The males when fully developed form about themselves a cocoon and after undergoing a complete metamorphosis issue therefrom in the adult form with a single pair of wings. They are minute in size and would not be observed by the plant grower. In fact the males of many species are little known scientifically.

Both sexes are active while young and travel from tree to tree where the limbs of an infested tree overlap the limbs of another. They are also blown about on leaves by the wind or carried by water. They are distributed in some instances by species of ants associated with them; and, in the course of commerce, are carried from one locality or country to another on their food plants or the products of the same.

OCCURRENCE IN HAWAII

The Avocado mealy-bug is first recorded in Hawaii by Mr. R. C. L. Perkins in 1902. He says:

> At the present time probably the two most injurious scale insects are the purple scale, *Mytilaspis citricola*, of the citrus trees and the white *Eriococcus?* of the alligator pear, guava, and other trees. Though the male scale of the latter is readily eaten by several ladybirds, a good enemy for the female is much needed.[4]

The writer in the annual report of this Station for the fiscal year ending June 30, 1902, says:

> The trees of the Hawaiian Islands suffer continually because of the presence of an unusual number of scale-insects, plant-lice, and mealy-bugs. One species of the latter pest (*Dactylopius* sp.) is at present doing great injury to the Alligator pear, or Avocado, in the vicinity of Honolulu. Many trees have died and all are injured to a greater or less extent. The application of kerosene emulsion has been used with success in several instances and will be advised as a remedy, together with proper pruning and cultivation.[5]

Mr. Wray Taylor in his report as Commissioner of Agriculture and Forestry for 1902, writes:

> The most troublesome blight that has made its appearance is the *Eriococcus* on the alligator pear, fig and guava trees. About four thousand small black ladybirds, name unknown to our entomologist, caught in Hilo, were scattered in and around Honolulu, but they have not done the work it was thought they would. Resin washes have been effective in many instances, and would be more so if those complaining of the blight would spend a little more time in using the washes.[6]

Specimens of the Avocado mealy-bug taken in Honolulu from the Avocado and guava were forwarded on Sept. 9, 1903, to Dr. L. O. Howard, Bureau of Entomology, U. S. Department of Agriculture. Dr. Howard replied under date of Oct. 3, 1903, that the material represented *Dactylopius nipae* Mask. Mrs. Fernald refers the species to the genus *Pseudococcus* in her catalogue. Mr. G. W. Kirkaldy in his "Preliminary List of the Insects of Economic Importance Recorded from the Hawaiian Islands"[7] and also in "A List of the Coccidae of the Hawaiian Islands"[8] records the species under the name *Trechocorys nipae* Mask., in his opinion both *Dactylopius* and *Pseudococcus* being synonyms. The first economic account of this species is by the writer in 1903.[9] Among others, a copy of this article was sent to Prof. T. D. A. Cockerell. Prof. Cockerell in acknowledgement said:

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[4] Rep. of the Governor, Ter. of Hawaii, Year ending June 30, 1902, Washington, 1902, pp. 35, 36.

[5] Ann. Rep., Hawaii Experiment Station, 1902, Office of Experiment Stations, U. S. Dep't of Agriculture, Washington, 1903, p. 325.

[6] Rep. of the Comm. of Agri. and For., Ter. of Hawaii, for the period ending Dec. 31, 1902, Honolulu, 1903, pp. 36, 37.

> With regard to *Dactylopius nipae*, there are two apparently distinct species which are usually confused and you might perhaps look at your form with this in view. The other species, *D. pseudonipae*, is best distinguished by the *male* being yellow. The antennae of *pseudonipae* (female) are always 7-jointed, those of *nipae*, 7 or 8-jointed. *D. pseudonipae* is usually found on palms.

On Feb. 12, 1905, the writer took specimens of a mealy-bug very similar to the Avocado mealy-bug from a palm *Acanthophoenix rubra* in Honolulu and forwarded the same to the Bureau of Entomology of this Department. These were determined by Mr. J. G. Sanders as *Pseudococcus pseudonipae* Ckll.

NATURAL ENEMIES.

Several ladybird beetles have been observed feeding on the Avocado mealy-bug of which one, *Cryptolaemus montrouzieri* Muls., is especially abundant. This species is a mealy-bug feeder and was collected by Koebele in Queensland in the Spring of 1894 and forwarded to Honolulu where it was received and liberated by Mr. Joseph Marsden, then Commissioner of Agriculture and Forestry. In his report for 1894, Mr. Marsden has the following regarding the work of this predaceous beetle.

> The work of one ladybird (*Cryptolaemus montrouzieri*), has been truly marvellous. A year ago, and for the past three years, all the citrus trees

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[7] Hawaiian Forester and Agriculturist, Vol. I, No. 6, 1904, p. 154.

[8] The Entomologist. (September), 1904, p. 227.

[9] The Mealy Bug or "Pear Blight" of the Alligator Pear. Press Bul. 8, Hawaii Experiment Station, Honolulu, 1903, pp. 6, figs. 3.

(such as the tamarind, orange, lime and lemon) were affected by a blight that was terribly destructive, so much so that it seemed that if relief was not soon obtained the citrus trees would all be destroyed. Many of the trees in fact did succumb to the effects of the blight which Mr. Maskell has named the *Dactylopius albizzia*. The Cryptolaemus soon got to work on this blight, and increased to such a wonderful extent that the ground, walls and fences were soon covered with full-grown, crawling, white larvae seeking suitable places to pupate and transform into the imago, or perfect stage. Tens of thousands of the larvae were collected and shipped to all parts of the Islands wherever any of the Dactylopids were known to exist. A great number were shipped to Kona to attack the coffee blight *(Pulvinaria psidii* Mask.), which also belongs to the Dactylopidae. For a time the most encouraging reports came of the work this ladybird was doing on the coffee blight, but latterly letters have been received stating that the bugs do not increase; this is but natural. The ladybirds have certain times for breeding, usually during the summer months, and during the winter they hibernate. This seems to be the case with the Cryptolaemus, for now hardly one can be found in Honolulu, where three months since hundreds of thousands were to be seen. The work of this bug has been so effective that many orange and tamarind trees that for the last three years have borne no fruit and looked as if they would eventually succumb, have this year come out in full foliage and fruit. Another serious blight (*Dactylopius longifilus*) made its appearance on the Samang and many other trees, and threatened to prove a troublesome pest. The Cryptolaemus, however, made short work of it, and hardly a vestige of it can now be found.[10]

This ladybird beetle is one of the most active of Koebele's introduced beneficial insects. Prof. Koebele says in his report for 1897, speaking of scale-insects:

> Up to the present time, some sixty species of these have been found on the Islands, and some of them would have made it utterly impossible to raise the citrus and coffee trees successfully, in fact, most of the shrubs and trees at the time were so infested by the then recently introduced and most pernicious coccid ever met with, *Dactylopius vastator* Mask., (*Pseudococcus filamentosus* ckll.) that their destruction in the near future seemed imminent had not relief been brought. Without doubt their destructive work would spread over all the Islands, notwithstanding the most diligent prevention on your part. The scale had not been met with as yet in any of the other Islands, and at present wherever it may appear, its enemies are awaiting it, the chief of which is the Australian ladybird, *Cryptolaemus montrouzieri* Mulsant.[11]

In speaking further of another mealy-bug, *Dactylopius ceri-*

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[10] Rep. of Comm. of Agri. and For., Rep. of the Minister of the Int., Republic of Hawaii, nine months ending Dec. 31, 1894, Honolulu, 1895, pp. 33, 34.

[11] Rep. of the Ent. to the Hawaiian Gov't. for the two years ending Dec. 31, 1897, Haw. Pl. Mo., Vol. XVII, No. 5, 1898, p. 208.

ferus Newstead, (*Pseudococcus virgatus* Ckll.) Koebele says that "This species also is kept in check by the Cryptolaemus beetles, which increase to such an extent in the early summer that millions of their larvae can frequently be seen crawling around where the coccids (mealy-bugs) abound."

Mr. F. W. Terry thus describes this beneficial beetle:

> Adult. Distinctly oval, the elytra (wing covers) black, except at the posterior extremities, which are similar in coloring to that of the thorax, i. e., orange brown. The fine whitish hairs which cover the body produce a somewhat greyish effect.
>
> Larva. The larva is really a dark brownish grey, but the body is completely hidden by a dense fluffy covering of white wax. Four longitudinal rows of white pointed filaments project irregularly beyond the general mass. The general appearance of this larva is so like that of a large mealy-bug, that they are often destroyed as such. Their active movements, however, soon enable the careful observer to distinguish them from their stationary prey. [12]

It is regrettable that this mealy-bug enemy is not as efficient a check to the pest under discussion as it has proved to be of certain other species and it follows that the fruit grower must employ active measures of suppression if he would grow the plants infested by the Avocado mealy-bug. A rather detailed account of the above ladybird beetle is given in order that the practical man may appreciate its value to him in its work against other enemies of his plants and recognize it as a species worthy of his attention and protection. On the other hand, when a plant becomes infested with an insect pest and it is obvious that if unchecked its presence becomes a menace to the development of the plant, the idea is absurd that spraying or fumigatation should not be employed because of the resulting iujury to the beneficial species associated with the pest. In no other country are the natural enemies of insect pests better understood or appreciated than in the United States yet the economic entomologists of the various agricultural institutions agree that to cease the active warfare against the enemies of the field and orchard would be nothing less than suicidal to the agricultural interests of the country.

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[12] The Hawaiian Forester and Agriculturist, Vol. 1, No. 11, 1904, p. 300, 301.

REMEDIES

Cultural methods:—Up to the present time there has been no effort to cultivate the Avocado or Alligator pear in these Islands. There are no orchards, as we understand such plantings on the Mainland. The conditions under which the trees are growing in closely planted door-yards, does not favor vigor and productiveness. The lack of cultivation and fertilization affects the vitality of a tree or plant and an unhealthy plant is readily attacked by its insect enemies and their increase promoted. Vigorous cultivation and supplying by fertilizers the needful plant food are recognized as direct aids to trees and plants in enabling them to withstand insect injury.

Kerosene emulsion:—The insecticide that will prove the most effective against the Avocado mealy-bug and other related pests is an emulsion of kerosene or coal-oil. The mixture is prepared as follows:

Dissolve one-half (½) pound of whale-oil soap (or any hard laundry soap shaved fine) in one (1) gallon of water while the water is boiling over a fire. When the soap is thoroughly dissolved, remove the solution a safe distance from the fire and pour it into two (2) gallons of kerosene (coal-oil). Empty coal-oil tins from which the tops have been removed will do as containers. While hot the mixture should be churned or agitated voilently until the oil is thoroughly emulsified with the soap and water solution. A perfect emulsion is best secured by using a strong force pump to pump the mixture back into itself, the nozzle having an opening throwing a direct stream. By this means a perfect emulsion can be made in from five to ten minutes. If the emulsion is perfect, it will on cooling have a thick, creamy consistency and *no free oil will rise to the surface.*

A good type of pump for use in preparing kerosene emulsion is illustrated in Figure 2 at B. The above mixture is a *stock* solution and must always be diluted before applying to the infested tree or plant. If on dilution free oil is in evidence, the mixture should not be used but the stock solution should be re-heated, being careful not to allow the oil to take fire, more soap should be added and the mixture again agitated. Very hard water will not make a good emulsion and if the water is hard, it may be found necessary to use rain water or soften the water by the addition of lye. The emulsion will keep perfectly well for several weeks and should not be diluted until wanted for use.

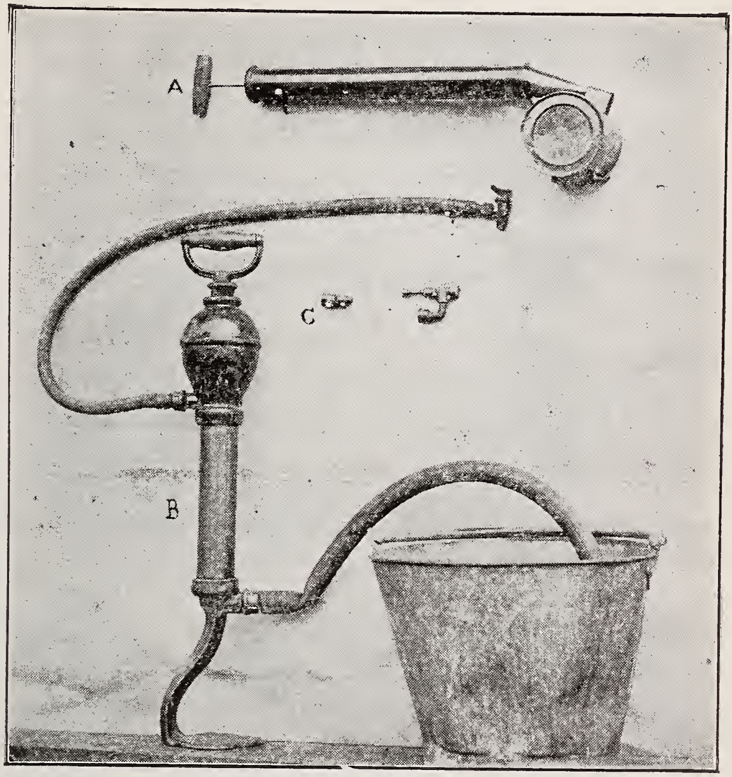

FIG. 2—A strong force pump (B), especially useful in preparing kerosene emulsion. The nozzle can be adjusted to throw either a direct stream or a spray. (original.)

Kerosene emulsion vs. *resin wash:*—The ingredients entering into the composition of kerosene emulsion are common commodities of the household while the substances used in the preparation of resin wash are not, and, in some instances, are not easily attainable. On the market in Honolulu they are, moreover, more expensive than in localities on the mainland. Kerosene emulsion can be made in a few minutes while the resin wash takes at least two hours of constant boiling and attention. Resin wash is preferably used while warm and in some instances must be re-heated before dilution because of a characteristic sediment on standing. Kerosene emulsion is easily diluted when cold and heating does not increase its effectiveness. Resin wash acts principally as a covering to the pests, killing by suffocation. This property necessitates its remaining on the infested plant for a considerable period and therefore, because of the variable and frequent rains, the quicker acting and caustic kerosene emulsion is better suited to Hawaiian conditions. Kerosene emulsion kills by contact and is practically immediate in its action. The resin wash has been used with great success in the control of certain scale-insects as a winter wash in temperate-zone localities where the absence of foliage permitted the use of a strong solution or in other localities during seasons when the absence of rain would insure the wash remaining on the plants for a period of several weeks.

Spraying:—In using the kerosene emulsion as a remedy for the Avocado mealy-bug, dilute one part of the stock solution with fifteen parts of water. Agitate the mixture thoroughly and apply with a spray pump. This strength is not sufficient to kill all the forms of the mealy-bug but is necessitated by the danger of injury to the foliage. Concentrated washes and strong solutions cannot be used in the warfare against plant pests in Hawaii because of the variability of plant growth and the fact that the plants are in constant leaf. The plants and trees are, in comparison to temperate-zone plants, quick growing and succulent with a resulting lessening of the power of resistance to the action of spraying mixtures. Many of the common trees and shrubs would be killed out by a single severe frost. As regards the Avocado, the above strength will kill the immature forms with the exception of the eggs and the very young still protected beneath the adult females.

The spraying should be repeated in about two weeks to kill the forms that have developed and dispersed over the tree in the meantime. In the case of badly infested trees it has been found necessary to spray still a third time, between three weeks and a month after the second application, to kill the immature forms that have arisen from the adults that escaped the previous operations.

If the trees are sprayed before the new growth starts preceding the bearing season, a much stronger solution may be used. A solution consisting of one part of the stock mixture diluted with only nine parts of water can then be applied. The old leaves are then dropping and there is no new growth to be injured. This strong solution should not be used before the old leaves begin to drop or after the new fruit and leaf buds start. One thorough spraying at this time with the above strength will kill nearly all of the mealy-bugs and if a second spraying with the weaker dilution is given after the new growth has started, the trees will be well cleaned of the pest. Thereafter the new growth should be carefully inspected for the appearance of the young forms and if observed, the spraying with the weak dilution should be repeated.

The base of the tree should be wrapped with gunny sacks during the operation of spraying to prevent the emulsion running down the trunks and, collecting at the crown, causing injury. The spraying should not be done in the noon-day heat of the sun for there is not only a greater possibility of injuring the foliage but also there is a rapid evaporation of the oil and a consequent lessening of the length of time for the emulsion to act on the pests. Spraying on windy days should also be avoided since the spraying is uneven, a great deal is wasted and evaporation is rapid.

The emulsion should be applied to the *insects* and not to the *tree*. All infested portions should be treated since a single infested branch if overlooked, becomes a menace to the rest of the tree. The emulsion must be applied as a finely divided spray or mist which when brought in close proximity to the infested portions of the tree will settle evenly over the mealy-bugs. Treat the inner part of the tree first and then commence at the top on the outside and spray one side of the tree at a time. Collect and destroy all leaves that fall and destroy all guavas growing wild in the vicinity of the trees since they harbor this pest.

Spraying apparatus: Through the efforts of this Station, several types of spray pumps and accessories suited to the present demands in Hawaii are on the market in Honolulu. The pump best adapted to prepare the emulsion has already been referred to and is shown in Figure 2. With the exception of areas devoted to pineapples and coffee and several plantings of fruit trees of greater or less extent (including Citrus, Avocado, Fig, Mango and Papaia trees) there is no demand for an elaborate spraying outfit. The general demand is for what might be termed a "dooryard outfit." After many trials, the most satisfactory and cheapest machine has proved to be a 5-gallon bucket outfit to which has been attached an extra length of hose and an extension rod. Such an outfit is illustrated in Figure 3. For the reason that a spray will not carry any distance the nozzle must be brought in close proximity to the part of the tree to be treated. This is done by means of the extension rod. Several barrel outfits mounted on wheels have been purchased for use by owners of larger plantings of fruit trees. The use of these results in a large saving of labor and time. The type is one selected by this Station and recommended after a thorough trial. Since the bucket outfit meets the present demand, it is deemed unnecessary to discuss the question of pumps more in detail. The Station invites inquiries on any phase of the subject and is prepared to give definite advice on the type of pump needed in any particular case, its cost, where it can be obtained and will give also personal instruction in the operation of spraying.

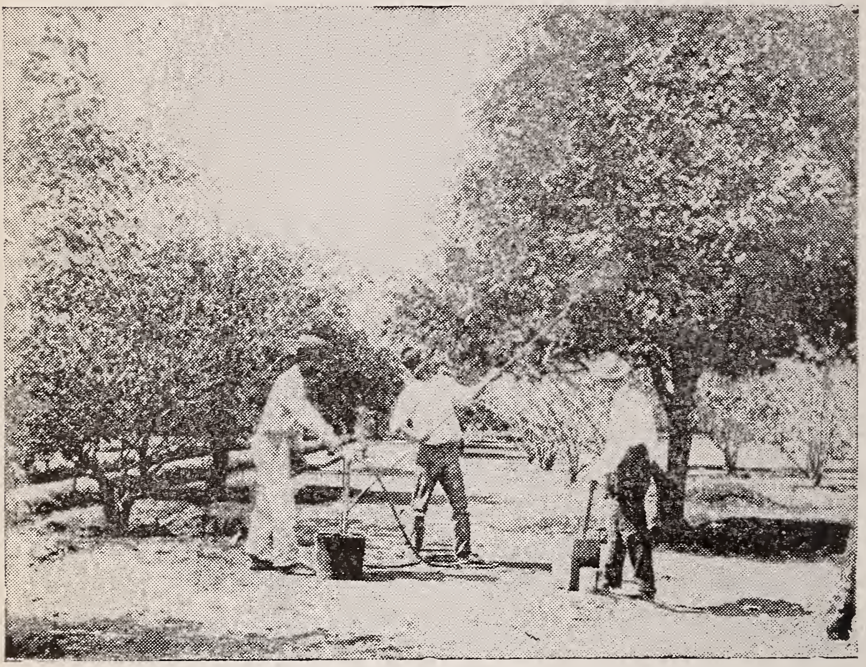

FIG. 3—Bucket-outfit supplied with an extra length of hose and an extension rod in use against a scale-insect on an orange tree. (original.)

Honolulu, T. H., *January 13, 1906.*